Workshop on Future Radio Technologies: Air Interfaces

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**ITU Overview**

Committed to connecting the world

**ITU-T**
Telecommunication standardization - network and service aspects

**ITU-D**
Promote and assist the extension of ICTs to all the world’s inhabitants - narrowing the digital divide

**ITU-R**
Global radio spectrum management and radiocommunication standardization

- **193** Member States
- **673** Sector Members
- **168** Associates
- **108** Academia
High-speed, affordable broadband connectivity to the Internet is a foundation stone of modern society, offering widely recognized economic and social benefits.

High-speed broadband is no longer just cutting-edge technology for an elite few; instead, the steady march of connectivity among the broader population is rapidly transforming our society with new ways of accessing services and information.

The International Mobile Telecommunications (IMT) framework encompasses both IMT-2000 and IMT-Advanced systems. All of today’s 3G and 4G mobile broadband systems are based on the ITU’s IMT standards.

IMT provides the global platform on which to build the next generations of mobile broadband connectivity.
ITU established the detailed specifications for IMT-2000 and the first “3G” deployments commenced around the year 2000.

In January 2012, ITU defined the next big leap forward in wireless cellular technology – IMT-Advanced – and this is now being progressively deployed worldwide.

The detailed investigation of the key elements of IMT-2020 is already well underway, once again using the highly successful partnership ITU-R has with the mobile broadband industry and the wide range of stakeholders in the 5G community.
Organizations involved in the development of IMT in ITU-R WP 5D

- 3GPP,
- 3GPP2,
- 4G Americas,
- 5G Infrastructure Public Private Partnership,
- 5G Innovation Centre,
- APT Wireless Group,
- Fifth Generation Mobile Communications Promotion Forum,
- ARIB,
- ATIS,
- CCSA,
- CDG,
- ETSI,
- EU METIS Project,
- GSMA,
- IEEE,
- IMT-2020 Promotion Group,
- ITRI,
- NGMN,
- NYU Wireless,
- TSDSI,
- TIA,
- TTA,
- TTC,
- UMTS Forum,
- WiMax Forum
- Wireless World Research Forum

*We welcome any other interested partners*
Enhanced Mobile Broadband

Gigabytes in a second

3D video, UHD screens
Work and play in the cloud
Augmented reality
Industry automation
Mission critical application, e.g., e-health
Self Driving Car

Smart Home/Building

Voice

Future IMT

Massive Machine Type Communications

Ultra-reliable and Low Latency Communications
• ITU-R WP 5D is working together with these partners in the same open process to establish the criteria for IMT-2020.


• The ITU Radiocommunication Assembly held in Geneva, 26-30 October 2015, approved Resolutions ITU-R 65 and 56-2 that establish the roadmap for the development of 5G mobile and the term that will apply to it: “IMT-2020”. 

**IMT-2020 studies**
Work on the next phases of IMT-2020 will ramp up in 2016, with the expected adoption in 2016/17 of the following deliverables:

• The Report on the **Technical Performance Requirements** that a technology would need to meet to satisfy “IMT-2020”

• The Report on **Evaluation Criteria and Evaluation Methods** for “IMT-2020” technologies

• The **Report on Specific Submission Requirements** of the candidate technology under assessment related to submissions, the evaluation criteria and submission templates

• **Communication via Circular Letters and Liaisons** will be a key element of the work.
Development of the requirements

• 5G requirements will be different because of the wide range of use cases creating distinctly different “wants” and potentially separate sets of requirement values
  • IoT, “Typical” Wireless Broadband, Video and other higher bandwidth applications (e.g., above 6 GHz)
• An ITU Circular Letter, will be initiated by ITU-R WP 5D in February 2016 to call for inputs and will also announce the process.
• Liaisons from WP 5D to External Organizations will solicit information seeking:
  • Understanding of the key characteristics to define the overall detailed requirement universe and subsequently the detailed information necessary to establish the actual parameter values
• A consensus driven process will set the actual values, or range of values
  • As noted above, there may be more than one set of values

• The resulting Key Characteristics and their values will be merged into an ITU-R Report
  • These values will be used as part of the evaluation criteria
  • Evaluation methodology and environments must be taken into account in the development of the requirements to ensure consistency
Proposal submission and Evaluation

• It is anticipated that the timeframe for proposals will be focused on 2018 (window spans late 2017 to mid-2019).

• The evaluation by independent external evaluation groups and definition of the new radio interfaces to be included in “IMT-2020” will take place from 2018-2020.

• Coordination with entities external to ITU-R will continue to be a cornerstone in the work.
• It is expected that **the final specifications** for the “global core specification (GCS)” from the external organizations (the technology proponents) towards the work on Draft new Recommendation ITU-R M.[IMT-2020.SPECS] *“Detailed specifications of the terrestrial radio interfaces of IMT-2020”* would be received into WP 5D Meeting #34 (February 2020) at the latest.

• **Transposed specifications** (from the individual regional or national transposing organizations) would be received by June 2020 at the latest.

IMT-2020 Standardization Process — Where we are and what is ahead

- Development Plan
- Market/Services View
- Technology/Research Kick Off
- Vision & Framework
- Name IMT-2020
- < 6 GHz Spectrum View
- > 6 GHz Technical View
- Process Optimization

2012-2015

- Spectrum/Band Arrangements (post WRC-15)
- Technical Performance Requirements
- Evaluation Criteria
- Invitation for Proposals
- Sharing Study Parameters (IMT-WRC-19)
- Sharing Studies (WRC-19)

2016-2017

- Proposals
- Evaluation
- Consensus Building
- CPM Report (IMT-WRC-19)
- Sharing Study Reports (WRC-19)

2018-2019

- Spectrum/Band Arrangements (WRC-19 related)
- Decision & Radio Framework
- Detailed IMT-2020 Radio Interface Specifications
- Future Enhancement/Update Plan & Process

2019-2020

Setting the stage for the future: vision, spectrum, and technology views

Defining the Technolog(y)(ies)
Detailed Timeline & Process For IMT-2020 in ITU-R


WRC-15

5D #18 5D #19 5D #20 5D #21 5D #22 5D #23 5D #24 5D #25 5D #26 5D #27 5D #28 5D #29 5D #30 5D #31 5D #32 5D #33 5D #34 5D #35 5D #36

Report Technology trends (M.2320)
Report IMT feasibility above 6 GHz (M.2376)
Recommendation Vision of IMT beyond 2020 (M.2083)
Modifications of Resolutions 56/57
Technical Performance Requirements
Evaluation criteria & method
Requirements, Evaluation Criteria, & Submission Templates
Circular Letters & Addendum
Proposals IMT-2020
Evaluation
Consensus building
Workshop
Outcome & Decision
IMT-2020 Specifications

Note: While not expected to change, details may be adjusted if warranted.
Outline of requirements

• The IMT-2020 requirements will provide the industry with a technical baseline for 5G
• (Examples, not exhaustive, of some minimum requirements)
  • Spectral efficiency
  • Bandwidth
  • Throughput; Peak & User Data Rates
  • Mobility
  • Latency
  • Capacity
  • Support of IoT
  • QoS
  • Energy Efficiency
5G Capability Perspectives from the ITU-R IMT-2020 Vision Recommendation

The values in the Figure 3 above are targets for research and investigation for IMT-2020 and may be further developed in other ITU-R Recommendations, and may be revised in the light of future studies.

Additional descriptions and further details for both Figure are in the IMT-2020 Vision Recommendation.
New radio interfaces

• The broad range of IMT-2020 requirements and use cases envisaged may necessitate specification of new radio interfaces as well as operation in new frequency bands
  • Extremely high data rates
  • Very low latency
  • Long range, low power applications

• Interworking with IMT-Advanced will need to be ensured

• Need to limit the complexity of terminal equipment (handsets, but more generally, things)
### New spectrum: Bands under study for WRC-19

<table>
<thead>
<tr>
<th>Existing mobile allocation</th>
<th>No global mobile allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>24.25 GHz – 27.5 GHz</td>
<td>31.8 – 33.4 GHz</td>
</tr>
<tr>
<td>37 – 40.5 GHz</td>
<td>40.5 – 42.5 GHz</td>
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<tr>
<td>42.5 – 43.5 GHz</td>
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<tr>
<td>45.5 – 47 GHz</td>
<td>47 - 47.2 GHz</td>
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<tr>
<td>47.2 – 50.2 GHz</td>
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<tr>
<td>50.4 – 52.6 GHz</td>
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<tr>
<td>66 – 76 GHz</td>
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<tr>
<td>81 – 86 GHz</td>
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Related ITU-R studies

ITU-R – radio standards and spectrum
• **SG1** - spectrum management, licensing, short range devices, cognitive radio
• **SG3** – propagation studies – incl. studies > 6 GHz
• **SG4** – satellite systems
• **SG5** – intelligent transport systems, sensor networks, IMT

ITU-T – fixed network aspects
• **SG13** - Future networks (& cloud)
• **SG20** - IoT and applications, smart cities
• Focus Group on IMT-2020 (FG IMT-2020)
Summary

- ITU-R WP5D has developed an overarching and coordinated plan
- Continues the Partnership with industry as the success model for 5G
- Much foundation work has already been completed, a lot of work is still required
- WRC-15 has allocated bands and invited further studies for above 6 GHz
- Next steps are to define the radio interface technology minimum performance requirements and evaluation details
  - 5G requirements will come from many different sources
  - More complex paradigm for development of requirements
  - Requirements provide a technical baseline for industry
  - Aggressive timeline